

Claims

- [c1] A method of filling vias in a silicon substrate, said method comprising:
 - obtaining a silicon substrate having a plurality of via holes;
 - filling said vias with a high-solids loading paste including a conductor material and a low CTE additive material;
 - and
 - sintering said silicon substrate and paste at a temperature for densification of said metal but not said low CTE additive material.
- [c2] The method of claim 1 further comprising having said paste in the range of 50 to 55 volume percent solids.
- [c3] The method of claim 1 including filling said vias with a metal powder.
- [c4] The method of claim 3 wherein said metal powder comprises copper, silver or gold powder.
- [c5] The method of claim 1 further including adding solvents and dispersants said high-solids loading paste.
- [c6] The method of claim 1 wherein said paste includes a

high-solids loading of approximately greater than 50 volume percent.

- [c7] The method of claim 1 wherein said paste has a suspension viscosity below approximately 1000 centipoise.
- [c8] The method of claim 1 including filling with said low CTE additive comprising a conductor, an insulator, or mixture of both.
- [c9] The method of claim 1 wherein said low CTE additive material comprises glass.
- [c10] The method of claim 1 wherein said low CTE additive material comprises silica, corderite, spodumene, borosilicate glasses, mullite, beta eucryptite, tungsten, magnesium aluminosilicate, or molybdenum.
- [c11] The method of claim 1 wherein said paste includes said low CTE additive material in a range of 20–80 volume percent.
- [c12] The method of claim 11 wherein said paste includes said low CTE additive material in a range of 50–75 volume percent.
- [c13] The method of claim 11 wherein said paste includes an amount of said conductor material is in the range of 20–80 volume percent.

- [c14] The method of claim 13 wherein said conductor material is in the range of 30-45 volume percent.
- [c15] The method of claim 1 further including rheologically tailoring said paste to improve said filling of said vias by combining rheology modifiers.
- [c16] The method of claim 15 including rheologically tailoring said paste by adding rheology modifiers on the order of 0.1 volume percent.
- [c17] The method of claim 1 wherein said sintering temperature of said conductor material is approximately 100°C less than said low CTE additive material sintering temperature.
- [c18] A method of filling empty vias in a silicon substrate, said method comprising:
 - placing said substrate in a vacuum chamber;
 - drawing a vacuum in said vacuum chamber;
 - flooding surfaces of said silicon substrate with a suspension;
 - raising pressure in said vacuum chamber;
 - wiping off excess suspension material;
 - drying said silicon substrate; and
 - sintering said substrate with filled vias.

- [c19] The method of claim 18 including said suspension comprising a conductive material and a low CTE additive material.
- [c20] The method of claim 19 including selecting said suspension such that said conductive material has a sintering temperature approximately 100°C less than said low CTE additive material sintering temperature.
- [c21] A suspension for filling via holes in silicon, comprising a high-solids loading paste including a conductive material and a low CTE additive material.
- [c22] The suspension of claim 21 further comprising having a portion of said suspension include solids in the amount of 50 to 55 volume percent.
- [c23] The suspension of claim 21 including having said conductive material comprise a metal powder.
- [c24] The suspension of claim 23 wherein said metal powder comprises copper, silver or gold powder.
- [c25] The suspension of claim 21 wherein said suspension including solvents and dispersants.
- [c26] The suspension of claim 21 wherein said suspension includes a high-solids loading of approximately greater than 50 volume percent.

- [c27] The suspension of claim 21 wherein said suspension has a viscosity below approximately 1000 centipoise.
- [c28] The suspension of claim 21 including said low CTE additive comprising a conductor, an insulator, or mixture of both.
- [c29] The suspension of claim 21 wherein said low CTE additive material comprises silica, corderite, spodumene, borosilicate glasses, mullite, beta eucryptite, tungsten, magnesium aluminosilicate, or molybdenum.
- [c30] The suspension of claim 21 wherein said suspension includes said low CTE additive material in a range of 20–80 volume percent, corresponding with an amount of said conductive material in the reciprocal range of 20–80 volume percent.